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PICKERING NGS 1990 VACUUM BUILDING OUTAGE - INSPECTION OF THE PRESSURE RELIEF DUCT EXPANSION/CONTRACTION JOINT SEALS

Report No. 90-204-K

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Abstract

During the Pickering NGS 1990 vacuum building outage the expansion/contraction joint seals in the pressure relief duct (PRD) were replaced. On the 'A' side of the PRD a total of five rectangular and four circular polyester reinforced neoprene rubber seals were replaced with polyester fabric reinforced silicone rubber seals. On the 'B' side of the PRD a total of nine rectangular and four circular fiberglass fabric reinforced silicone rubber and one rectangular polyester fabric reinforced silicone rubber seals were replaced with polyester reinforced silicone rubber seals. This replacement was documented extensively by photographs and videotape. In addition, the seal splicing procedure was videotaped. Inspection was also made of old seals, backup plates and embedded parts. Durometer hardness tests were made on the wall sections of all the seals and also on the floor sections and splices of five of the rectangular seals and all of the circular seals. The variation in hardness readings was small and well within specified values. Finally, each seal, in its finished installed condition, was videotaped for future reference.

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32-143-553	833.4	September 4, 1990	90-204-K

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EXECUTIVE SUMMARY

PICKERING NGS 1990 VACUUM BUILDING OUTAGE - INSPECTION OF THE PRESSURE RELIEF DUCT EXPANSION/CONTRACTION JOINT SEALS

R.J. Lewak

During the Pickering NGS 1990 vacuum building outage, the expansion/contraction joint seals in the pressure relief duct were replaced. on the 'A' side of the PRD a total of five rectangular (at contraction joints between sections of the PRD) and four circular (at contraction joints joining the PRD to the reactor buildings) polyester fabric reinforced neoprene rubber were replaced with polyester fabric reinforced silicone rubber seals. The 'A' side seals were replaced because of increasing hardness and therefore decreasing flexibility of the splices. On the 'B' side of the PRD a total of nine rectangular and four circular fiberglass fabric reinforced silicone rubber and one rectangular polyester fabric reinforced silicone rubber seals were replaced with polyester fabric reinforced silicone rubber seals. These fiberglass reinforced seals had experienced previous failures under pressure tests due to a manufacturing defects in the fiberglass fabric which essentially reduced the seal strength by 80 to 90%. During the 1990 'as found' pressure test of the PRD prior to work in the PRD one rectangular fiberglass reinforced silicone rubber seal failed and two circular fiberglass reinforced silicone rubber seals developed tears due to these manufacturing defects.

The old seals and contraction joints were inspected as the seals were being replaced. Many of the embedded parts and backup plates of the contraction joints required refurbishing due to corrosion. Using the old seal as a template, the new seal would have the bolt holes punched in it using a hand punch. After the embedded parts and backup plates were refinished, the seal would be mounted starting with the ceiling sections and working towards both walls, then down the walls to the floor. Before the seal

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would be mounted in the floor section the splice in the seal was made by a representative of the seal manufacturer, Freudenberg NOK. Following splicing the seal would be mounted to the floor section and the bolts would undergo the final torque of 67.8 N-m. Inspections of the bolt torques and baseline durometer hardness measurements were then taken followed by videotaping the entire length of the seal for future reference. One test coupon of spliced and four test coupons of unspliced 1 meter long lengths of seal were mounted on the north wall at various locations. The baseline durometer hardness measurements were all within specified levels.

It is concluded that the replacement of the expansion/contraction joint seals in the Pickering NGS PRD was performed in a regular, professional manner. A few errors that did occur were corrected efficiently and promptly. It is, however, recommended that better communication between departments involved in the seal replacement be established for any future replacement as many of the errors could be eliminated by better communication. It is also recommended that the seal hardness be monitored biennially.

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PICKERING NGS 1990 VACUUM BUILDING OUTAGE - INSPECTION OF THE PRESSURE RELIEF DUCT EXPANSION/CONTRACTION JOINT SEALS

R.J. Lewak

1.0 INTRODUCTION

The pressure relief duct (PRD) is an elevated, rectangular reinforced concrete structure running east-west and supported by concrete frames set on steel piles with the centerline a height of 25 m (82 ft) above grade. The total length of the duct is 661.4 m (2170 ft) and the internal width is 6.1 m (20 ft) and height is 7.6 m (25 ft). The wall and roof thickness is 0.61 m (2 ft) and the floor thickness is 0.76 m (2.5 ft). The PRD is connected to the vacuum building by the vacuum ducts and isolated from the vacuum building by the pressure relief valves. The PRD is connected to each reactor building by a 2.44 m (8 ft) long cylindrical reinforced concrete branch connection having an internal diameter of 7.62 m (25 ft). The PRD and its relationship to the vacuum and reactor buildings is shown in Figure 1.

The PRD is not a continuous concrete structure but is composed of sections which are connected by various joints such as expansion/contraction, hinge and construction joints. The joints which are open to the atmosphere are the expansion/contraction joints (CJs) and require to be sealed in order to maintain containment. The PRD was built in two different sections, the 'A' side and the 'B' side. The 'A' side runs from 6.9 m (22.5 ft) east of the centerline of Reactor Building 1 westward a distance of 248 m (813 ft) past Reactor Buildings 1 to 4 as shown in Figure 2. Figure 2 shows the location of joints along the PRD 'A' length. CJs are numbered 5, 10, 14, 18, and 23. These CJs are

rectangular in shape except that their corners are splayed. This This is shown in Figure 3. If one were looking from inside the PRD the seal shape in these C's along the walls, ceiling and floor would be concave as shown in Figure 4. However, in order to fit the seal around the corners, the seal must change curvature so that at the corners the seal has a convex curvature as seen from inside the PRD. At the junction of the branch connection between the Reactor Buildings and the PRD are circular expansion/contraction joints. These joints are number 29, 30 , 31, and 32 for Unit 1, Unit 2, Unit 3, and Unit 4. These CJs are circular and their seals have a concave curvature all along the circumference, although not as pronounced a curvature as the rectangular seals. The CJ seals in the 'A' side were made of polyester fabric reinforced neoprene rubber by Dunlop Canada Ltd. in the 1960's and are coloured black. The reasons for the replacement of these seals are annotated in Reference 1.

The 'B' side of the PRD was constructed at a later time than the 'A' side. It runs eastward from just east of the Unit 1 centerline a distance of 414 m (1357 ft) past Units 0, 5, 6, 7, and 8 as shown in Figure 5. The CJs are indicated by circles and are numbered 0, 36, 40, 44, 48, 53, 58, 62, 66, and 71. These are all rectangular C's as shown in Figure 3 and the seals have the same curvature as the 'A' side rectangular seals. Units 5 to 8 have circular CJs numbered 77, 78, 79, 80 respectively. The circular CJ seals have the same curvature as the 'A' side. All of the 'B' side seals were manufactured from fiberglass fabric reinforced silicone rubber except for the CJ 71 seal which was made from polyester reinforced silicone rubber and are coloured red. All the 'B' side seals were made by Armet, Ltd. (now Freudenberg NOK). The reasons for the seal replacement are given in references 2 and 3.

All of the twenty-three CJ seals in the PRD were replaced using a seal made from polyester fabric reinforced silicone rubber manufactured by Freudenberg NOK (formerly, Armet Ltd) of Tillsonburg, Ontario and are coloured red. Both the polyester fabric and the silicone rubber have a different composition from the polyester and rubber used in the old seals.

2.0 FAILURES OF OLD SEALS DURING 'AS FOUND' PRESSURE TEST

Prior to any seal replacement, the PRD was pressurized in an 'as found' pressure test in which the leakage of the PRD is measured at pressures up to 41.4 kPag (6 psig). During the May 1990 'as found' pressure test of the PRD a pressure of 41.4 kPag was never reached due to tears or ruptures in three CJ seals. The three seals were all fiberglass reinforced silicone rubber seals on the 'B' side and were at CJ 44, CJ 78 (Unit 6) and CJ 79 (Unit 7). The failure at CJ 44 occurred in the top north corner. Tears in both CJ 78 (Unit 6) and CJ 79 (Unit 7) occurred in the factory splice area. For the time period following the pressure

test the PRD still had high concentrations of tritium so that access was restricted. Furthermore, although Chemical Research personnel expressed great interest in examining the seal failures in situ, in the great haste to begin work on the critical path activity of seal replacement, Pickering Operations removed the CJ 78 (Unit 6) and CJ 79 (Unit 7) seals before they could be examined in situ. The request by Chemical Research to leave the torn circular seals in place was received by Pickering Operations after these seals had already been removed as removal of the circular seals was the very first activity in the workplan and adherence to the critical path schedule required removal of the seals immediately following the 'as found' pressure test. The seal at CJ 44 was still in place when we were allowed to examine the failures, however, and the failure is shown in Figures 6 to 9. From the appearance of the failure it would seem that failure occurred due to a manufacturing flaw in the fiberglass fabric located in a high stress area, namely a corner. This is similar to the previous failures in the 'B' side rectangular seals/4/, the cause of which has been described previously/2/.

The CJ 78 (Unit 6) and CJ 79 (Unit 7) seals were removed to a loading bay, checked for contamination and released to Chemical Research. Figures 10 and 11 show the failure of the CJ 78 (Unit 6) seal and Figures 12 and 13 show the failure in the CJ 79 (Unit 7) seal. Both seals failed at the factory splice and analysis has shown that the same type of flaw in the fiberglass fabric was the major cause of failure/5/.

3.0 INSPECTION OF OLD SEALS AND EXPANSION/CONTRACTION JOINTS

As the seals were being replaced, personnel of Chemical Research had the opportunity to inspect several old CJ seals which had not been removed at that time and also inspect several CJs which had seals removed.

The old polyester reinforced neoprene seals used in the 'A' side CJs, were, by and large, free from any apparent damage caused by age during the time since installation. Figure 14 shows the circular seal at CJ30 (Unit 2). The seals were, of course, quite dirty, especially the floor section, which, being in a depression, tended to collect all manner of dust and debris. Figure 15 shows the south bottom corner of seal CJ5.

As for the backup plates and the embedded parts (EPs), these were inspected as the old seals were removed. Figure 16 shows the EPs for the circular CJ 31 at Unit 3. Figure 17 shows the north wall at CJ18. Notice the chink of outside light coming through in the photo center. These two figures are average in showing the extent of work that was required to refinish the EPs and the surfaces of the backup plates. Figure 18 shows evidence of a bird's nest in a

bottom corner behind CJI5. The light gaps and the bird's nest indicated that repairs were also required to the exterior weather covers around the CJs.

On the 'B' side, aside from dirt and debris on the seals there were no apparent damage to the seals from aging. Figure 19 shows the north wall of CJ71 which has the newest of the old seals and is made of polyester reinforced silicone rubber. However, there was a definite presence of water which is believed to have come into the PRD from a leaking hinge joint which was subsequently repaired during the outage. This is shown in Figure 20 which is a bottom corner of CJ58 and Figure 21 which is a bottom corner of CJ53. Water damage is also apparent from the corrosion damage on CJ44 shown in Figure 22.

The backup plates and EPs on the 'B' side suffered from much the same corrosive damage as that on the 'A' side but to a lesser extent. Figure 23 shows the circular CJ 79 at Unit 7 and Figure 24 shows a close-up of the damage on the circular CJ 77 at Unit 5.

4.0 PRD SEAL REPLACEMENT

The replacement of the PRD seals was performed in a non-uniform fashion. Basically, the stages of seal replacement included removal of the old seal which was then used as a template for punching the bolt holes in the new seal. At the same time the holes were punched, the backup plates and embedded parts would be undergoing reconditioning. Once the holes were punched and the CJ ready to receive a new seal, seal installation would first take place by bolting the ceiling section first and then the walls. The floor would be left to last and not done until the splicing was completed. Once the splice was completed, the floor section would be bolted down and the final torque level applied to all the bolts. Any cover plates such as those on the floor would then be replaced. Because each CJ is unique as to access difficulties, seal replacement was not performed in any regular order. Generally, the circular seals from both the 'A' and 'B' side were replaced first, next the 'B' rectangular seals and lastly, the 'A' rectangular seals with CJ5 the last completed as it had the most difficult access as it is between the pressure relief valves.

4.1 Cutting Bolt Holes

Figure 25 shows a contraction joint seal as it arrived at PNGS and had been put on a stand. The first task in installation of the seal was to punch the bolt holes. The punches for these holes are shown in Figure 26. The holes are not punched in the CJ seals before installation because the distances between bolts varies in the CJs. To punch the holes in the correct location one of the methods used was to use the old seal as a template while punching

the holes as shown in Figure 27. Another method, shown in Figure 28, was to mark the location of the holes by measurement and then to punch the holes. The worker in Figure 28 is wearing a plastic suit because the air in the PRD during the first week of the outage had a high tritium concentration. A typical punched hole is shown in Figure 29.

4.2 Fitting the Seal Onto CJ

Once the bolt holes had been punched and the embedded parts and backup plates reconditioned, the seal installation began by installing the seal onto the ceiling of the CJ beginning at the center and working toward the walls. Figures 30 to 32 show the workers using SKYJACKS to install the ceiling section of a rectangular seal. Next the wall sections were installed and the floor section, in which the splice was made, is kept rolled up and off the floor to prevent damage until the splice is made. The circular seals fitting was done in the same manner with the top being fit on first and then down around each side of the circumference to the bottom. At the bottom a 60° arc of the seal was left unbolted until after the splice was made.

4.3 Errors in Seal Installation

During the installation of the seals a number of errors were made. These errors were corrected after they had been inspected by Chemical Research personnel who then made recommendations as to eliminating these errors. The first error was encountered in the circular seal at CJ 80 (Unit 8). On this seal, as shown in Figure 33, the bolt holes were originally punched in the seal so that there was poor positioning between the bolt holes and the bolt locations. As can be seen, the result when the seal is installed is a wrinkled seal. The critical part of the wrinkle is beneath the backup plates as the wrinkles will prevent the backup plates, seal and embedded parts from seating smoothly and therefore sealing correctly. This error was corrected by removing this seal and making another seal entirely, from the hole punching to the fitting to the splicing. This second seal at CJ 80 (Unit 8) was correctly made and was satisfactory.

The second error was encountered in the circular seals at CJ 78 (Unit 6) and CJ 79 (Unit 7). It had originally been recommended by Chemical Research that the punched holes in the seal be sealed against moisture ingress by a coating of room temperature vulcanized (RTV) rubber which should be applied immediately following hole punching. However, it was decided prior to the outage that this recommendation should not be followed as it was too difficult to perform correctly over the more than 8000 holes which are punched in all the seals. This recommendation was followed on the seals of CJ 78 (Unit 6) and CJ 79 (Unit 7), though, with results as shown in Figures 34 and 35. As can be seen the excess RTV will prevent the seal from

seating properly on the embedded parts and the backup plates and will cause leaks. To rectify the situation, the excess RTV was scraped from the surface of the seal and the surface buffed smooth before installation of the backup plates.

A third error occurred in the seal at CJ66. In this case a small 6 cm x 4 cm gouge was taken in the cover rubber. This gouge in the rubber was repaired by filling in the gouge with uncured silicone rubber and then curing the rubber in a press under temperature and pressure in the same manner as a splice is made. The repair is shown in Figure 36.

A fourth error occurred in the seal at CJ36. For some reason the length of the seal was measured incorrectly and the seal was not long enough to fit completely around the joint. Therefore two splices were required to be made, both on the floor span section. Although the seal specification written in 1989 requires that only a single splice be present in the seal, the previous specification for the seals written in 1979 allowed for two splices. The other seals have just one splice, of course. This situation was judged acceptable in that the splice strength is specified as 90% of the seal strength in which case the existence of two splices was not judged to be too deleterious to seal strength. The positioning of the second splice was also acceptable.

4.4 Seal Splicing

The seal comes in one continuous piece which must be spliced together for seal continuity. The splices in all 23 CJ seals were made by Mr. Bob Haggarty, an employee of Freudenberg NOK, the manufacturer of the CJ seals.

The splice is a 10.2 cm (4 in) overlap splice so the seal ends were prepared for splicing as follows:

1. The seal end was squared off and then a line was drawn 10.2 cm (4 in) from the end.

2. A dull knife (so as not to cut the fabric) was then used to cut the rubber down to the fabric along this line and at 1.3 cm (1/2 in) wide intervals to the end of the seal as shown in Figure 37.

3. The 1.3 cm rubber strips are then removed from the fabric as shown in Figures 38 and 39. This procedure was then repeated on the opposite side of this seal end as shown in Figure 40. This left one end of the seal with just the fabric.

4. The procedure is then repeated on one side of the other end of the seal.

5. Both ends of the seal are then cleaned with acetone as shown in Figures 41 and 42 and then protected using a plastic bag as shown in Figure 43.

The seal is then made ready for splicing by inserting the lower half of the press beneath the two ends as shown in Figure 44. The splicing procedure was as follows:

1. On one end of the seal was placed the splicing compound which is uncured silicone rubber of the same type in the seal as shown in Figure 45. The splicing compound has the dimensions of 11.4 cm wide by 38.1 cm long by .05 cm thick (4.5 in x 15 in x 0.02 in). The compound was trimmed to the seal dimensions and smoothed over the fabric as shown in Figure 46.

2. The other end was brought together with the first to form an overlap as seen in Figures 47 and 48. The splice now looks like Figure 49.

3. Then a 0.13 cm (0.05 in) layer of splicing compound was laid over the exposed fabric as shown in Figure 50, trimmed to seal dimensions and smoothed over the fabric.

4. The gaps on both sides of the splice were then filled by cutting strips of splicing compound, filling in the gaps with these strips and smoothing the rubber so that the surface is even. This procedure is shown in Figures 51 to 53. The splice was then ready for curing as shown in Figure 54.

5. The top half of the press was then placed on the splice, the pressure in the press increased to 410 kPa (60 psi) by air pressure and the temperature of the press raised to 160^{o}C (320^{o}F) as shown in Figure 55. Once the temperature reaches 160^{o}C the splice was kept at that temperature for one hour

6. After one hour the heating elements were disengaged and the pressure removed. The press was opened and removed. A completed splice is shown in Figure 56, which is the splice in CJ5.

4.5 Final Seal Installation Procedures

Once the splice was made on a seal the final procedures were to fit the floor or bottom section to the embedded parts and to install the remaining backup plates. It then remained to adjust the torque on the bolts to the final value of 67.8 N-m (50 ft-lb). Following the final torquing of the bolts, the torque of randomly selected bolts was measured to insure the correct torque had been applied on each seal. The floor plates were then replaced after the floor section had been vacuumed and cleaned. Hardness measurements were then made on the seal wall sections

and, if the floor plates could be removed easily, on the floor sections and on the splice and adjacent to the splice. The seal's entire exposed length was then videotaped for future reference. In certain cases the seals were, contrary to written procedure, caulked along the backup plates with polysulphide. This, it is believed, only occurred on two circular seals. It is not required, though, but it does no harm to the seal. Lastly, the bottom corner area of each rectangular seal was sheltered by tape and cloth covers to prevent excess grit and dirt falling into the floor sections. These covers were removed, however, just prior to the 'as left' pressure test. In many cases, also, corner sections of the rectangular seals were caulked with RTV by Pickering Operations during the 'as left' pressure test although there was no leakage evidence to support this decision.

4.6 Test Coupons

Since the removal of any part of a PRD is impossible without breaching containment, it was necessary to make test coupons of the seal material and expose it to the same conditions the seals would undergo. Therefore, at regular intervals along the north wall of the PRD, coupons of 1 m of seal material, both spliced and unspliced were affixed. one of these coupons is shown in Figure 57. If the seal is required to be tested for mechanical or chemical characteristics in future years, samples may be taken from these test coupons with the knowledge that the test coupons have undergone the same environment as the seals.

5.0 DUROMETER HARDNESS MEASUREMENTS

Hardness measurements were taken on all the seals as well as the test coupons. The splices of all seals are on the floor which is normally made inaccessible by a cover plate. Due to the construction schedule, inspection periods did not always coincide with periods during which the cover plates were removed. Therefore, not all of the splices' hardnesses were measured. However, as there was not a large variation in the measured splices' hardness, it can be assumed that all the splices' hardness were within this variation. Hardness measurements were made using a Shore A durometer hardness tester close to the backup plates where there was sufficient support surface.

Contraction Joint	North Wall	South Wall	Slice	Next to Splice
0	60,63,60	64,64,64	-----	----------
5	64,64,65	62,65,63	65,60, 65,65	63,67,62,67
10	63,64,65	60,60,60	------	----------
14	67,63,65	67,61,64	65,66,68 63,64,65	65,70
18	65,60,65	64,62,64	69,65,62 60,65,65	70,70
23	63,64,63	64,65,63	------	----------
Unit 1 CJ 29			64,65,66	64,63
Unit 2 CJ 30			57,59,55	55,60
Unit 3 CJ 31			59,58,59	57,56
Unit 4 CJ 32	56,59		54,58,57	54,55,54
36	64,62,61	64,64,58	S:68,68,69 67,67 N:65,67,64 65,68	---------- ----------
40	63,65,65	62,65,65	---------	----------
44	65,63,65	65,63,60	---------	----------
48	65,60,62	65,62,58	---------	----------
53	60,61,61	61,60,58	67,66,66 66, 66	----------
58	60,60,65	65,65,60	--------	----------
62	65,65,65	60,64,63	--------	----------

Contraction Joint	North Wall	South Wall	Slice	Next to Splice
66	64,64,66	64,64,66	--------	----------
71	60,61,64	64,60,65	60,67,64 67	64,60,64,62
Unit 5 CJ 77			53,52,51	58,60,55
Unit 6 CJ 78			54,55,54	58,54
Unit 7 CJ 79			55,57,53	57,55
Unit 8 CJ 80	60,63		60,65,59	59,60,60

Coupons: All Hardness Values = 65

It should be noted that these hardness values can only be used for comparison with other hardness values at a later time. The surface beneath the seal is variable for each joint and is in no way comparable to the surface required in the ASTM standard for durometer hardness.

6.0 PHOTOGRAPHIC AND VIDEOTAPE RECORDING

As mentioned previously, the seal replacement procedure including the entire splicing sequence was both photographed and videotaped. In addition, each seal on the 'B' side as well as the circular seals on the 'A' side were videotaped in their entirety in their finished condition. Certain areas of these seals were, however, inaccessible, notably the floor section in most cases. Unfortunately, due to equipment malfunction, the videotape of the rectangular seals on the 'A' side did not record. The videotape record of the PRD seals is being kept on file at Materials Chemistry Section of the Chemical Research Department.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Generally, the replacement of the expansion/contraction joint seals in the Pickering NGS PRD was performed in a regular, professional manner. The few errors that occurred during this replacement are testimony to this statement. The errors that did occur such as the RTV on Unit 6 and 7 seals could be eliminated by better communication between the departments involved such as Civil Design, Pickering Engineering, Pickering Operations, Pickering Construction and Chemical Research as to the plan of

installation. It is recommended that for the next replacement of this type that lines of communication be established between those responsible for particular work in the replacement from each department involved.

It may also be concluded that both the seal and the seal splice hardness are within acceptable specified values for all the seals. It is recommended, however, that this hardness be monitored biennially for any signs of seal hardening.

8.0 ACKNOWLEDGEMENTS

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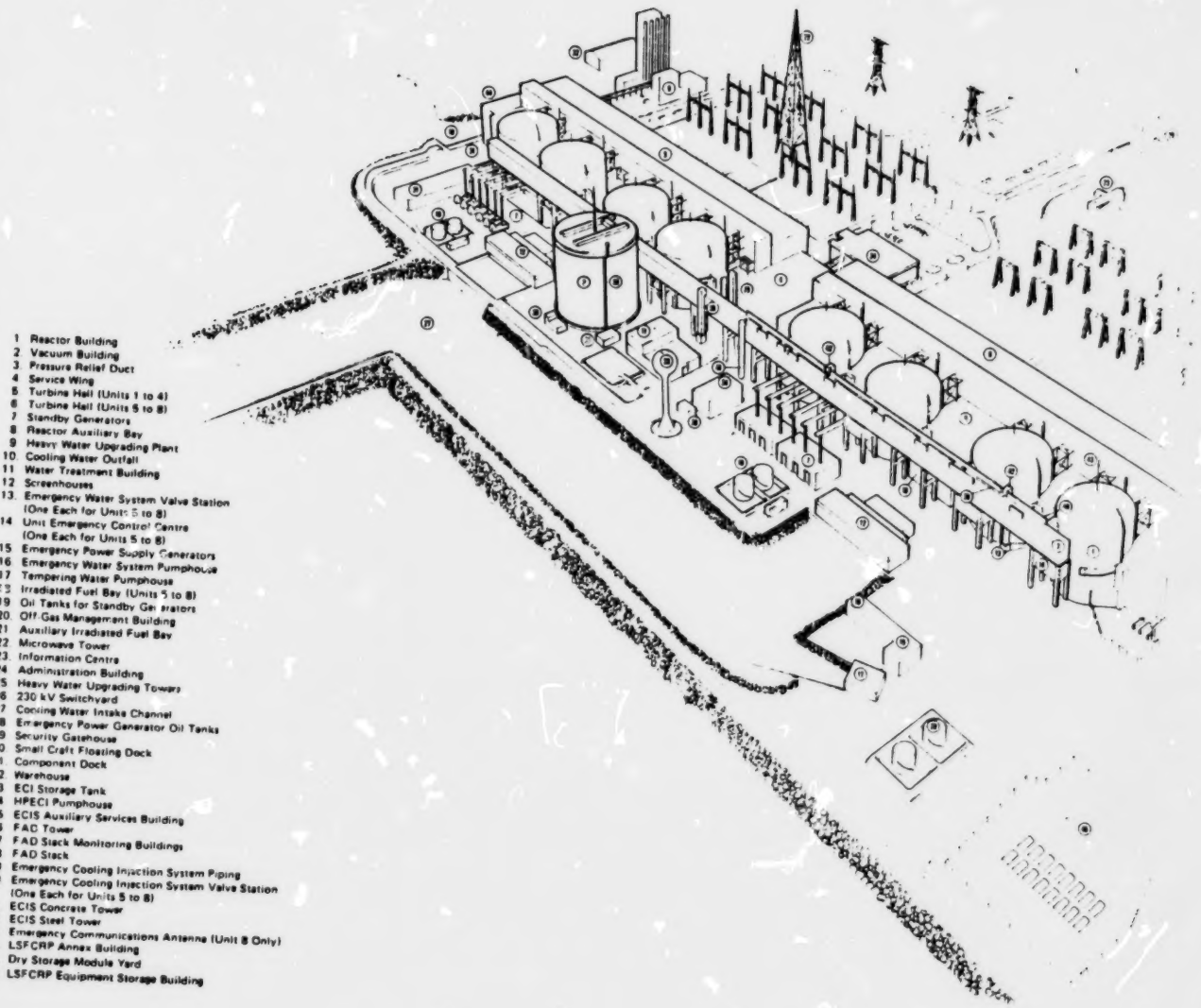

1 Reactor Building
2 Vacuum Building
3 Pressure Relief Duct
4 Service Wing
5 Turbine Hall (Units 1 to 4)
6 Turbine Hall (Units 5 to 8)
7 Standby Generators
8 Reactor Auxiliary Bay
9 Heavy Water Upgrading Plant
10 Cooling Water Outfall
11 Water Treatment Building
12 Screenhouses
13 Emergency Water System Valve Station (One Each for Units 5 to 8)
14 Unit Emergency Control Centre (One Each for Units 5 to 8)
15 Emergency Power Supply Generators
16 Emergency Water System Pumphouse
17 Tempering Water Pumphouse
18 Irradiated Fuel Bay (Units 5 to 8)
19 Oil Tanks for Standby Generators
20 Off-Gas Management Building
21 Auxiliary Irradiated Fuel Bay
22 Microwave Tower
23 Information Centre
24 Administration Building
25 Heavy Water Upgrading Towers
26 230 kV Switchyard
27 Cooling Water Intake Channel
28 Emergency Power Generator Oil Tanks
29 Security Gatehouse
30 Small Craft Floating Dock
31 Component Dock
32 Warehouse
33 ECI Storage Tank
34 HPECI Pumphouse
35 ECIS Auxiliary Services Building
36 FAD Tower
37 FAD Stack Monitoring Buildings
38 FAD Stack
39 Emergency Cooling Injection System Piping
40 Emergency Cooling Injection System Valve Station (One Each for Units 5 to 8)
41 ECIS Concrete Tower
42 ECIS Steel Tower
43 Emergency Communications Antenna (Unit 8 Only)
44 LSFCRP Annex Building
45 Dry Storage Module Yard
46 LSFCRP Equipment Storage Building

Figure 1 Pickering NGS Layout

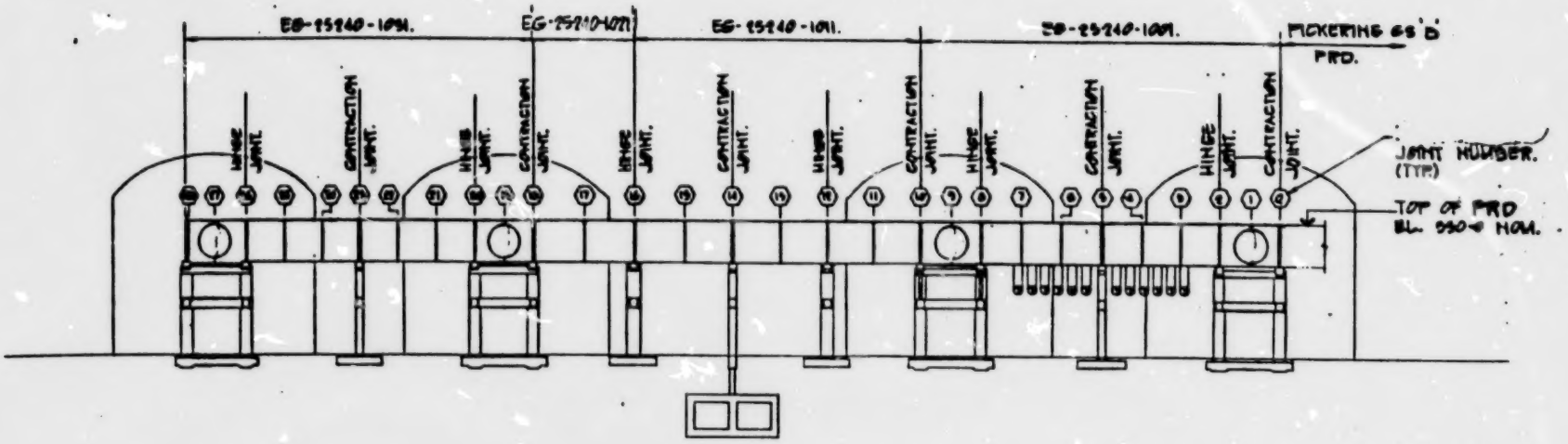

Figure 2 "A" Side of Pickering NGS PRD

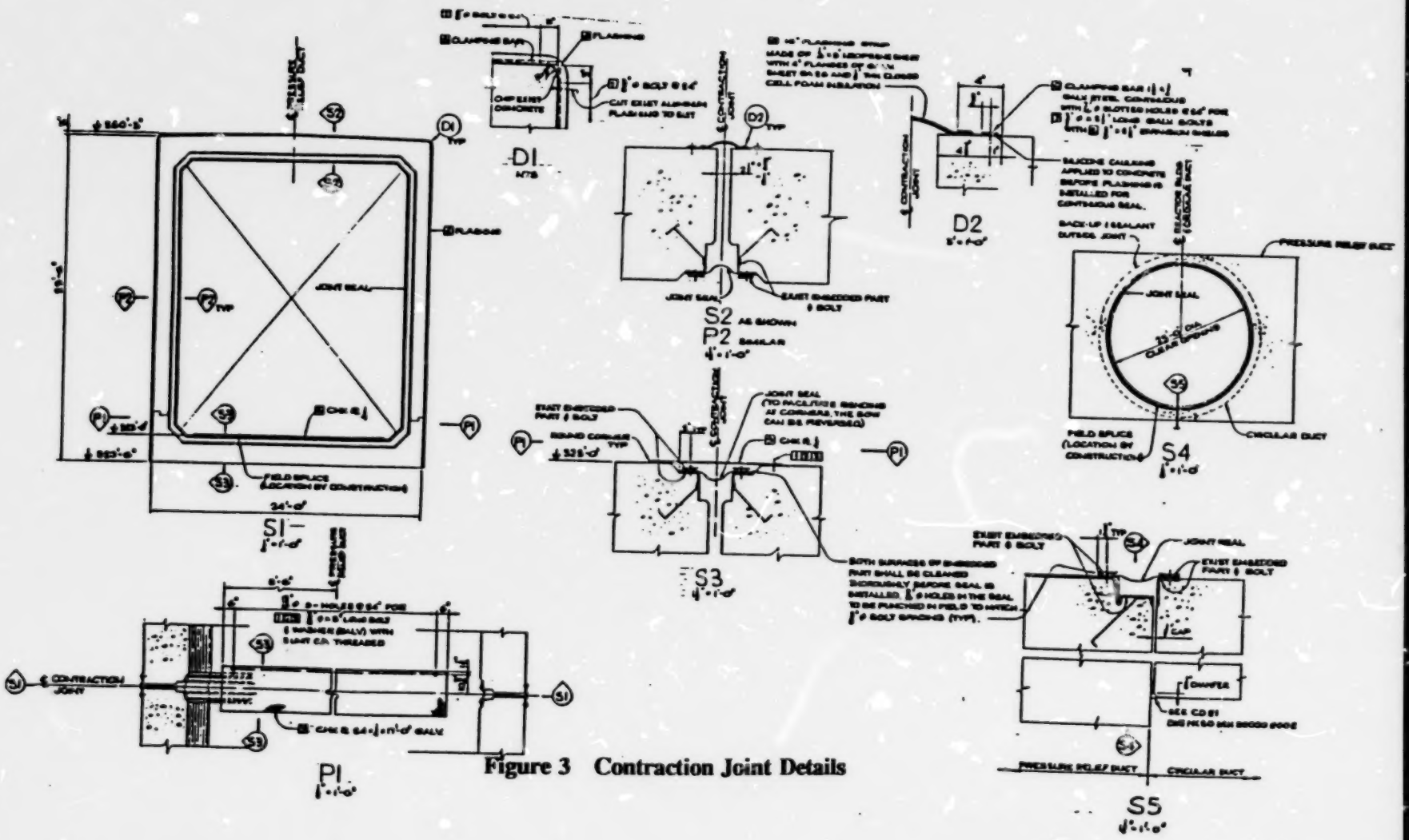

Figure 3 Contraction Joint Details

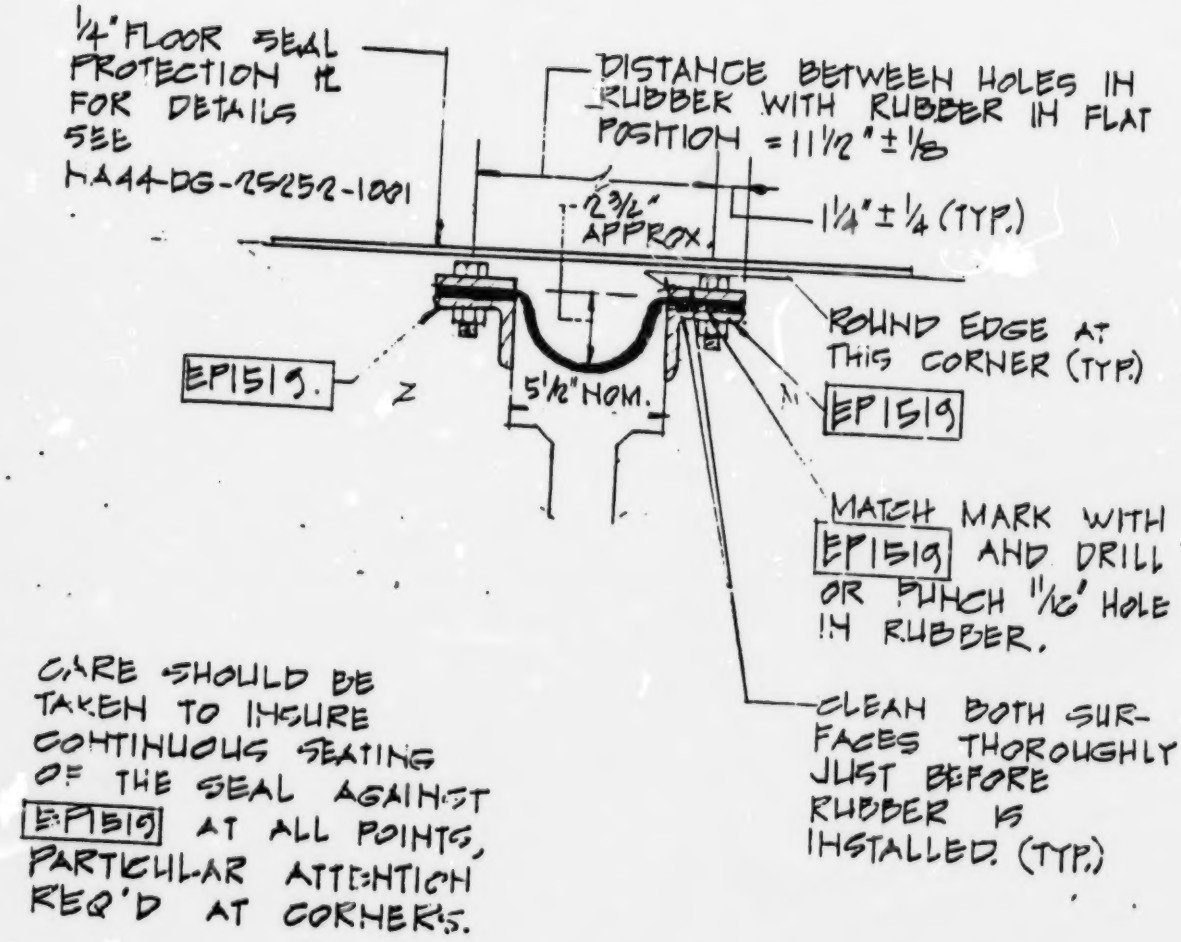
1/4" FLOOR SEAL PROTECTION PL FOR DETAILS SEE MA44-DG-25252-1001
DISTANCE BETWEEN HOLES IN RUBBER WITH RUBBER IN FLAT POSITION = 11 1/2" ± 1/8
2 3/4" APPROX.
1 1/4" ± 1/4 (TYP.)
ROUND EDGE AT THIS CORNER (TYP.)
EP1519
EP1519.
Z
5 1/2" NOM.
MATCH MARK WITH EP1519 AND DRILL OR PUNCH 11/16" HOLE IN RUBBER.
CLEAN BOTH SURFACES THOROUGHLY JUST BEFORE RUBBER IS INSTALLED. (TYP.)
CARE SHOULD BE TAKEN TO INSURE CONTINUOUS SEATING OF THE SEAL AGAINST EP1519 AT ALL POINTS, PARTICULAR ATTENTION REQ'D AT CORNERS.

Figure 4 PRD CJ Seal Details

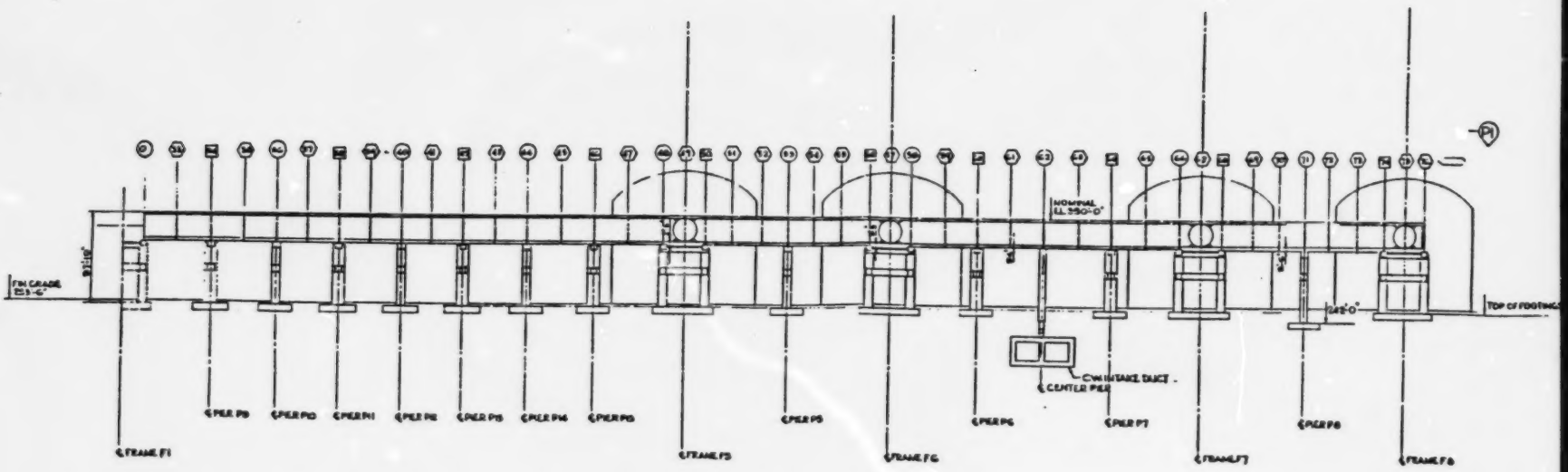

Figure 5 "B" Side of Pickering NGS PRD

Figure 6 Failure in Top North Corner of Seal at CJ 44

Figure 7 Failure in Seal CJ 44

Figure 8 Failure in Seal CJ 44

Figure 9 Inspection of Failure at Top North Corner of Seal at CJ 44

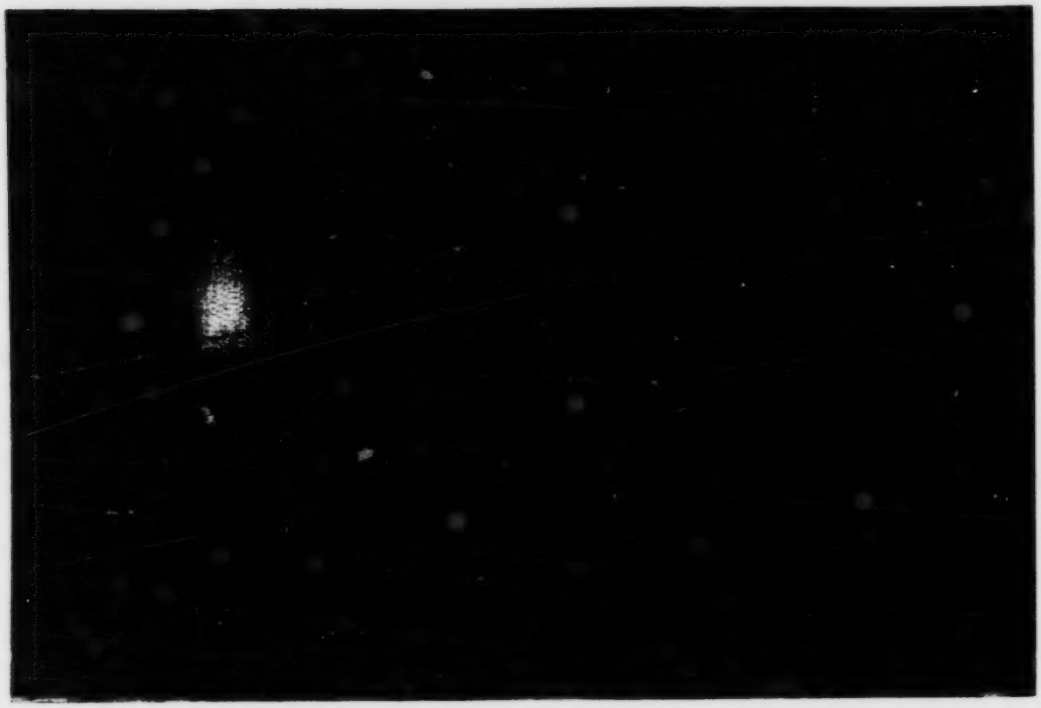

Figure 10 Failure at Unit 6 Seal

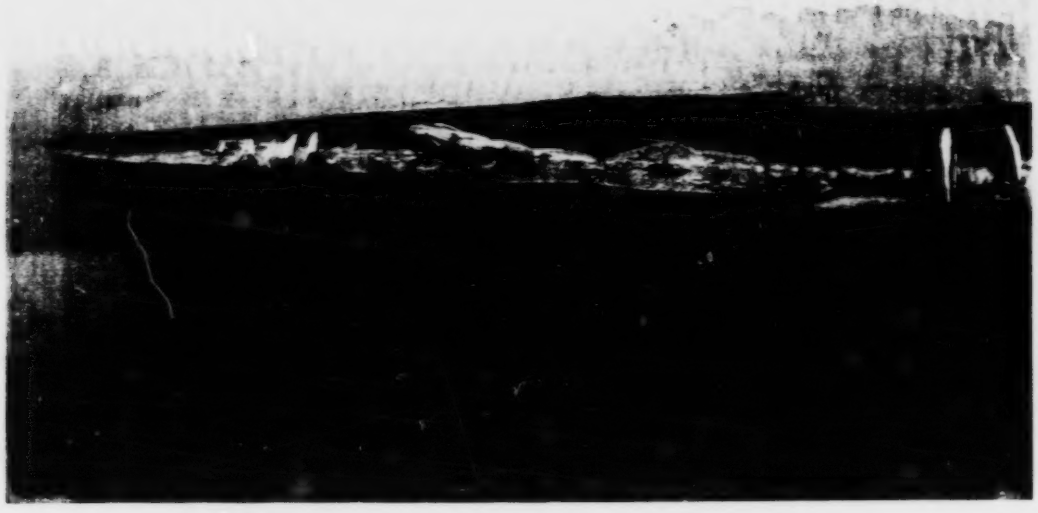

Figure 11 Close-Up of Unit 6 Seal Failure

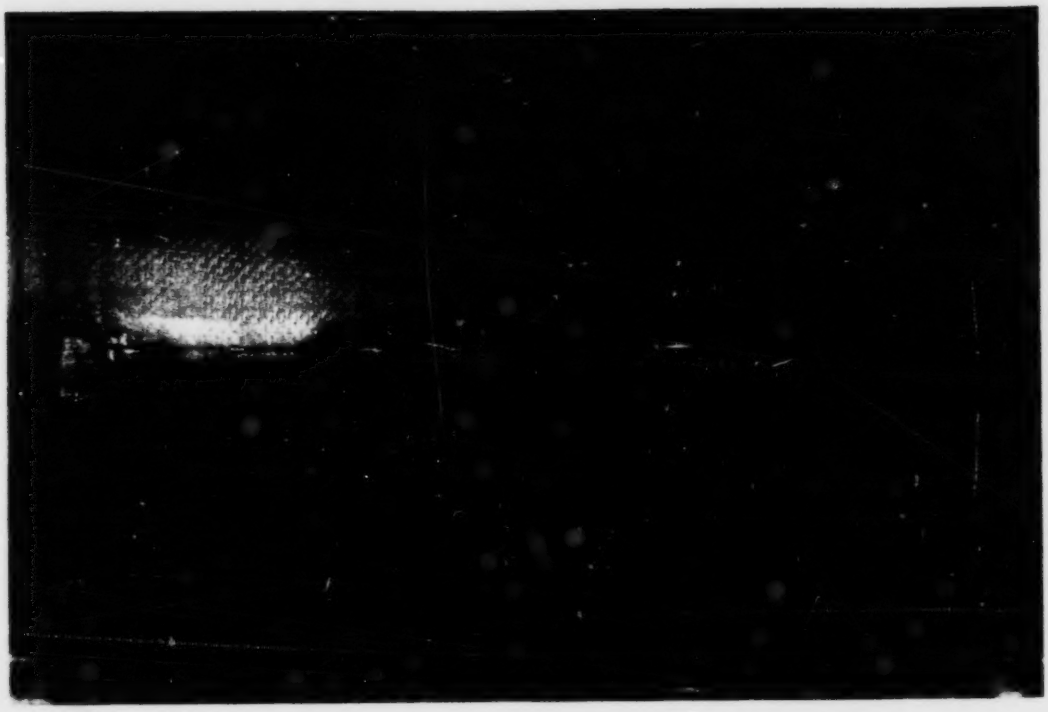

Figure 12 Failure in Unit 7 Seal

Figure 13 Close-Up of Failure in Unit 7 Seal

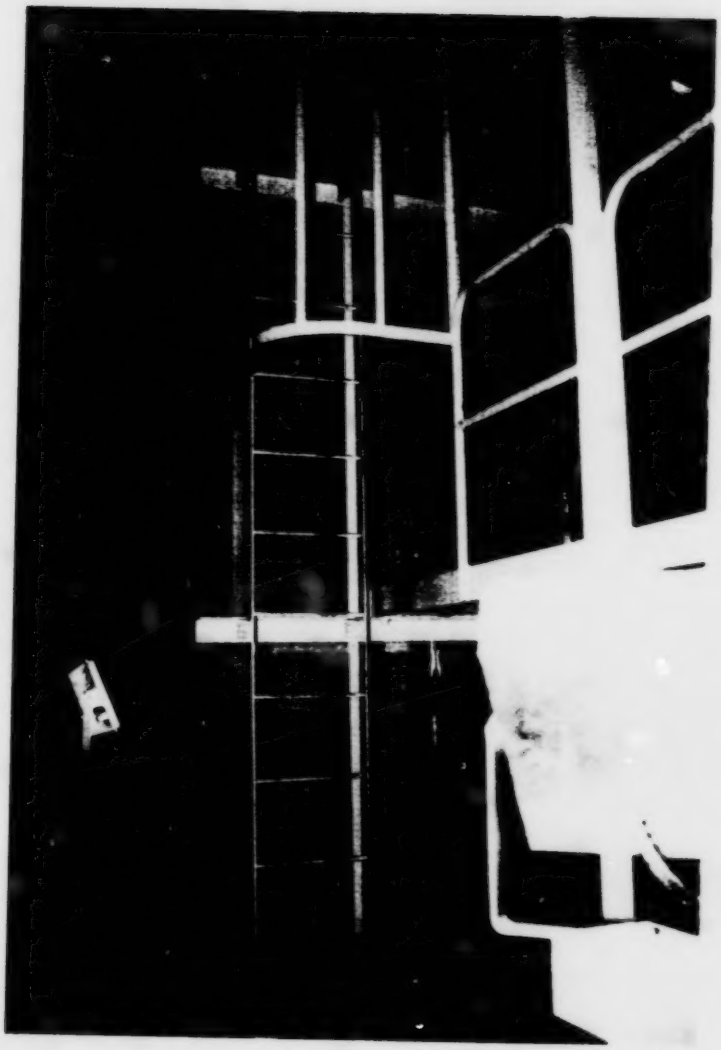

Figure 14 Old Polyester Fabric Reinforced Neoprene Rubber Seal on Unit 2 CJ

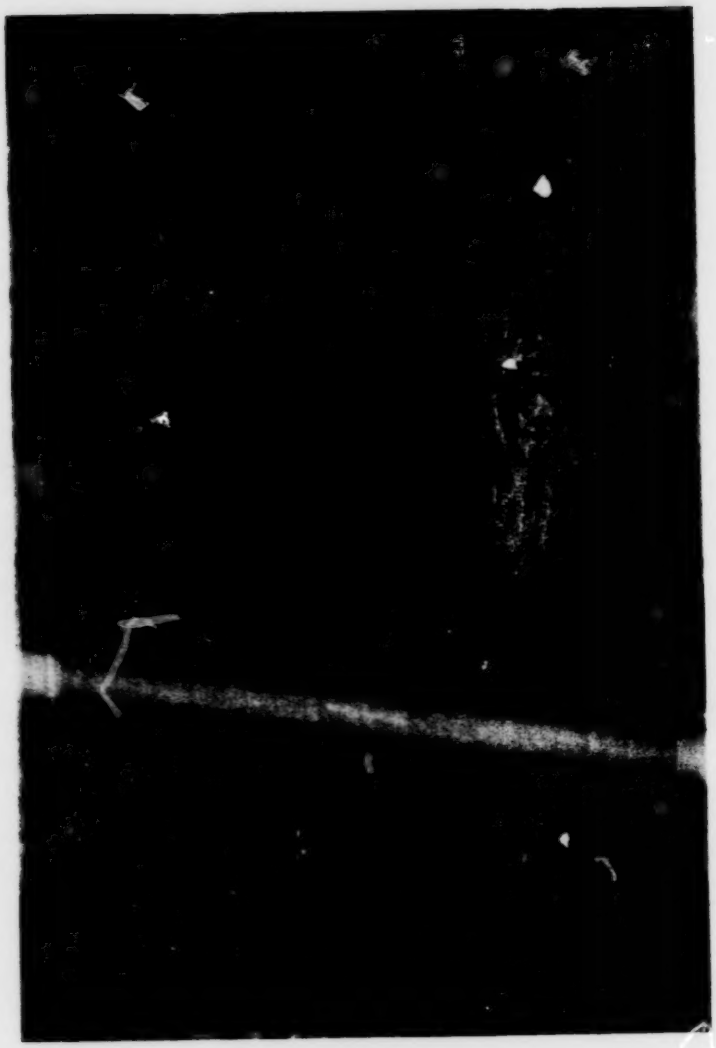

Figure 15 South Bottom Corner of Seal CJ 5 Old Polyester Reinforced Neoprene Rubber

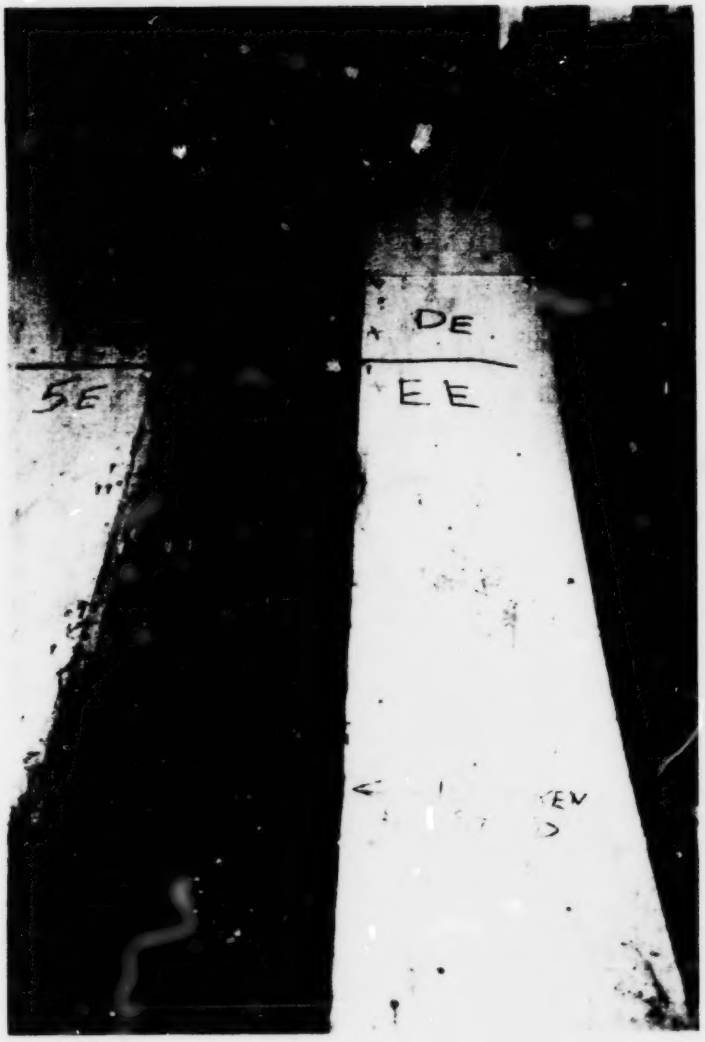

Figure 16 Embedded Parts at Unit 3 CJ

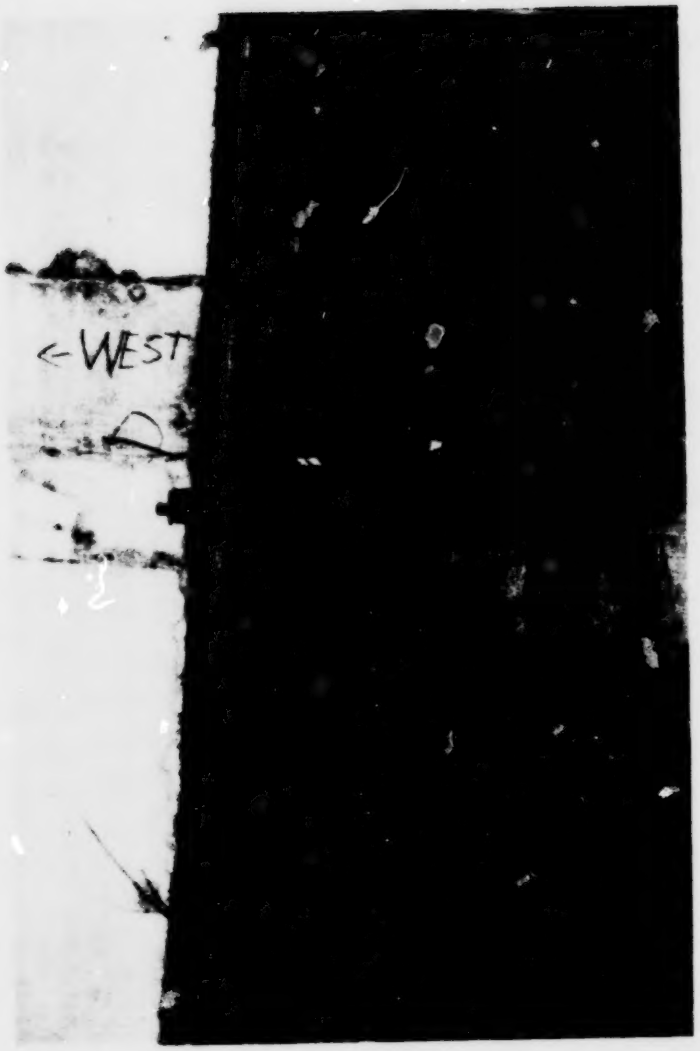

Figure 17 North Wall of CJ 18

Figure 18 Evidence of Bird's Nest in Bottom Corner of CJ 14

Figure 19 North Wall of Seal CJ 71 Polyester Reinforced Silicone Rubber

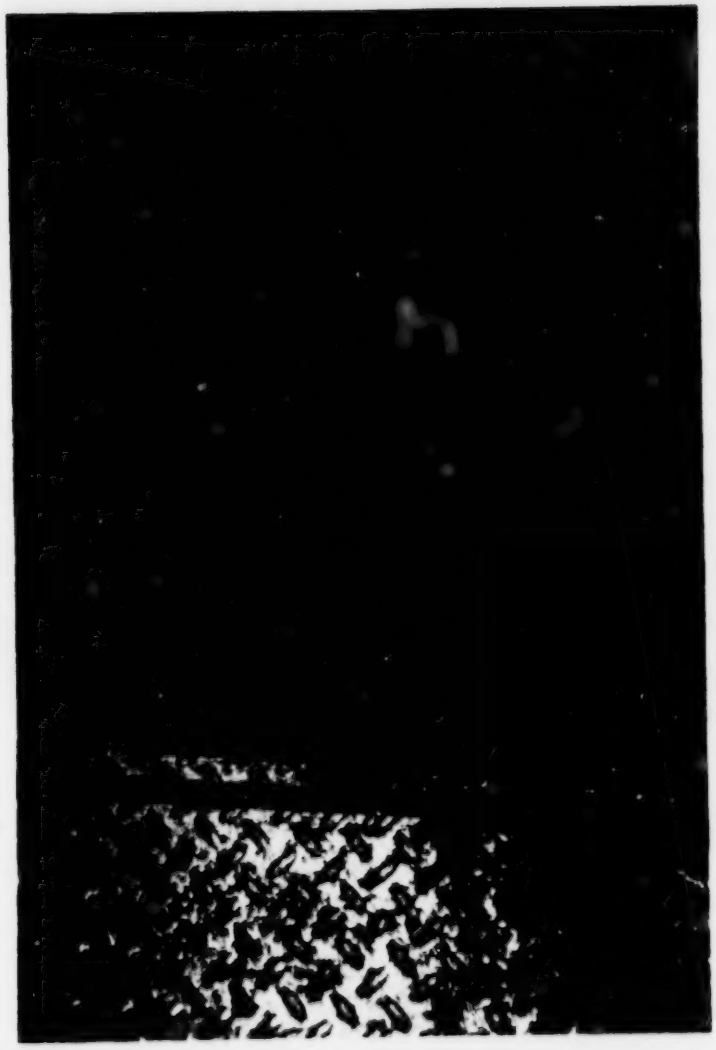

Figure 20 Bottom Corner of Seal at CJ 58

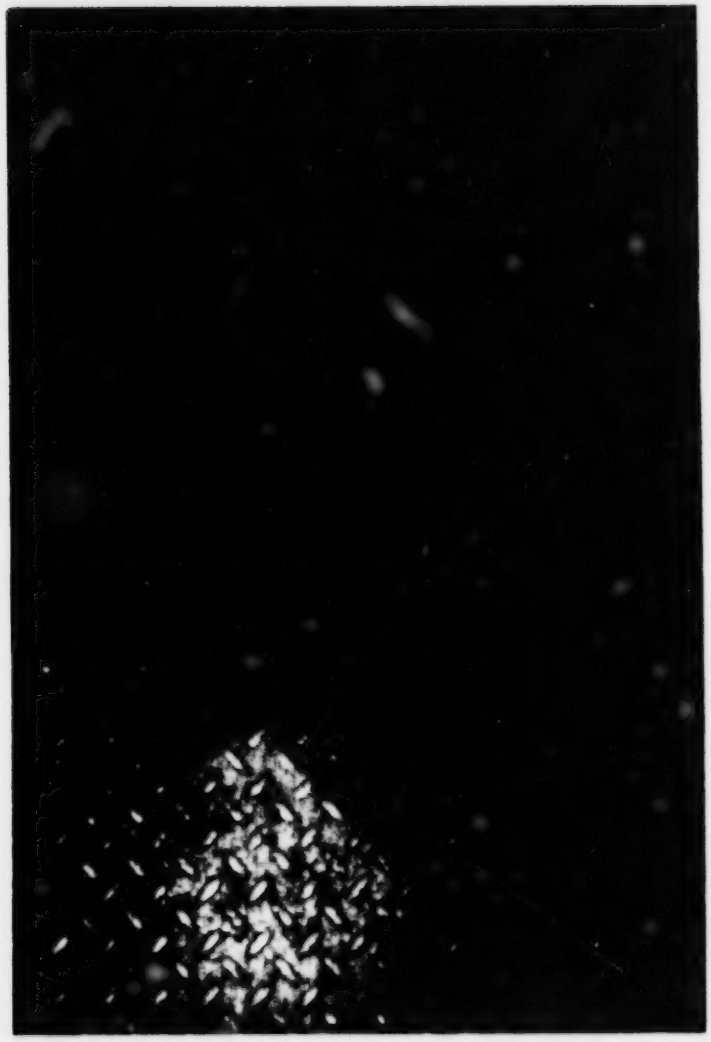

Figure 21 Bottom Corner of Seal at CJ 53

Figure 22 Bottom Corner of Seal CJ 44

Figure 23 Unit 7 CJ

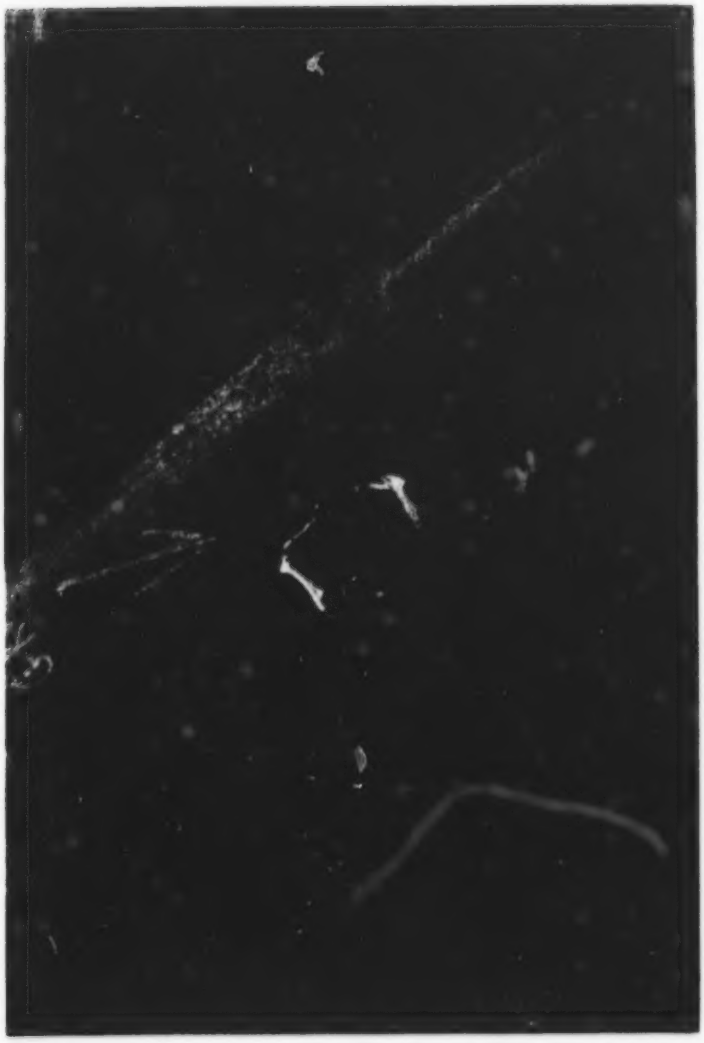

Figure 24 Damage at Unit 5 CJ

Figure 25 Contraction Joint Seal as Delivered at PNGS

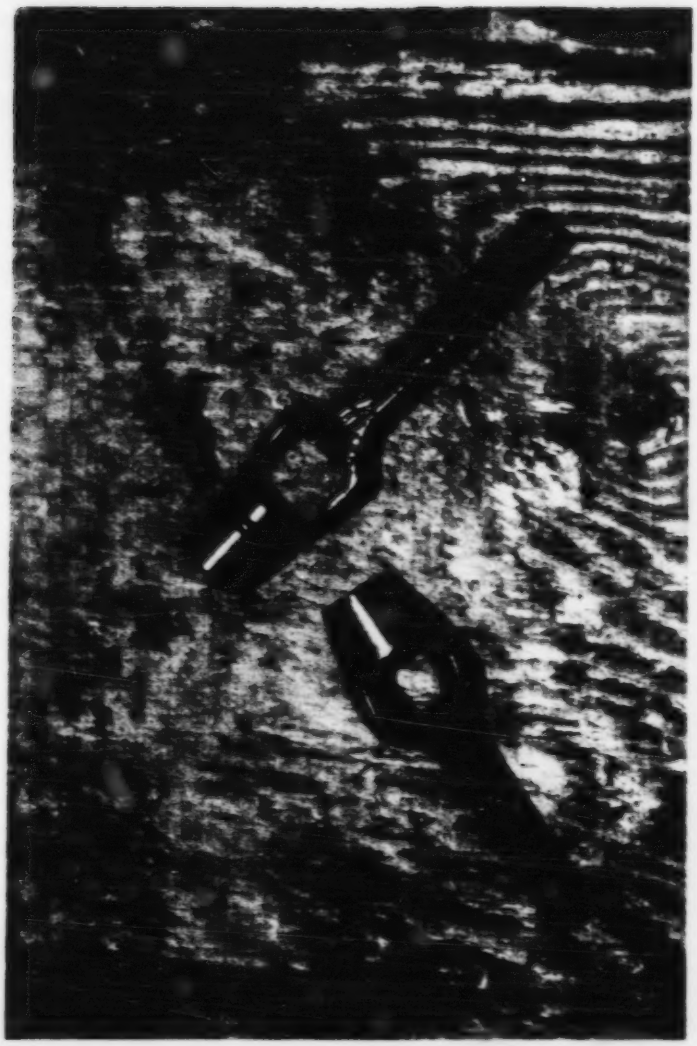

Figure 26 Punches Used for Cutting Holes in Seals

Figure 27 Using an Old Polyester/Neoprene Rubber Seal as a Template to Punch Bolt Holes in New Seal

Figure 28 Punching Bolt Holes in New Seal
Bolt Locations
Marked on Seal

Figure 29 Typical Punched Bolt Hole in New Seal

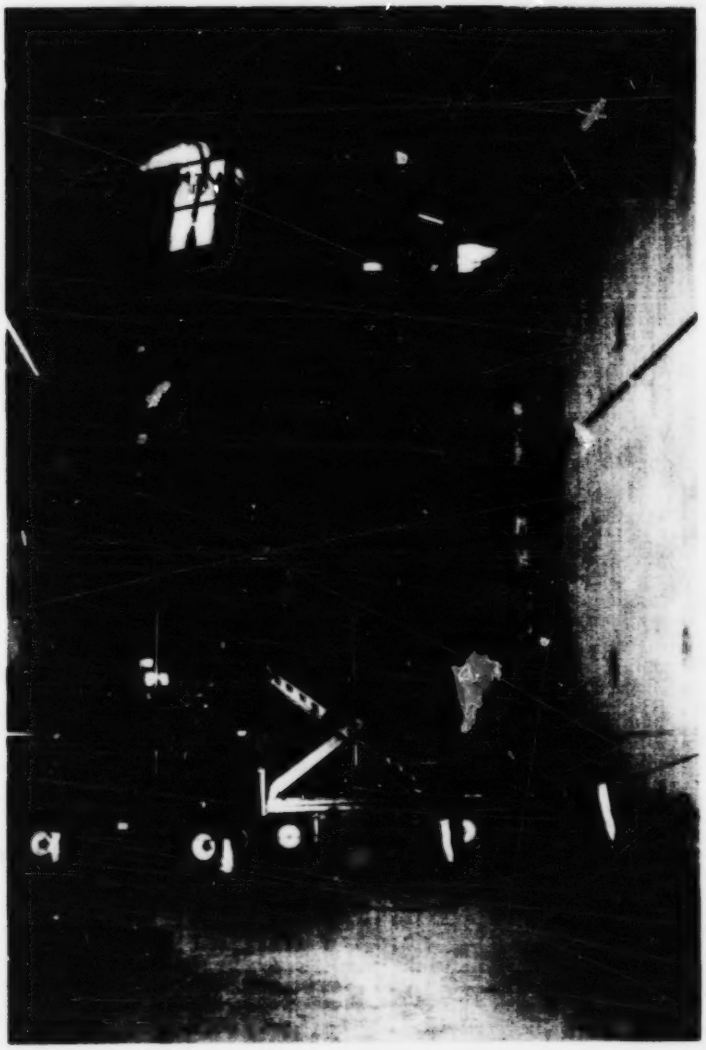

Figure 30 Installation of New Seal Using Skyjacks

Figure 31 Installation of Ceiling Section of New Seal

Figure 32 Installation of Ceiling Section of New Seal

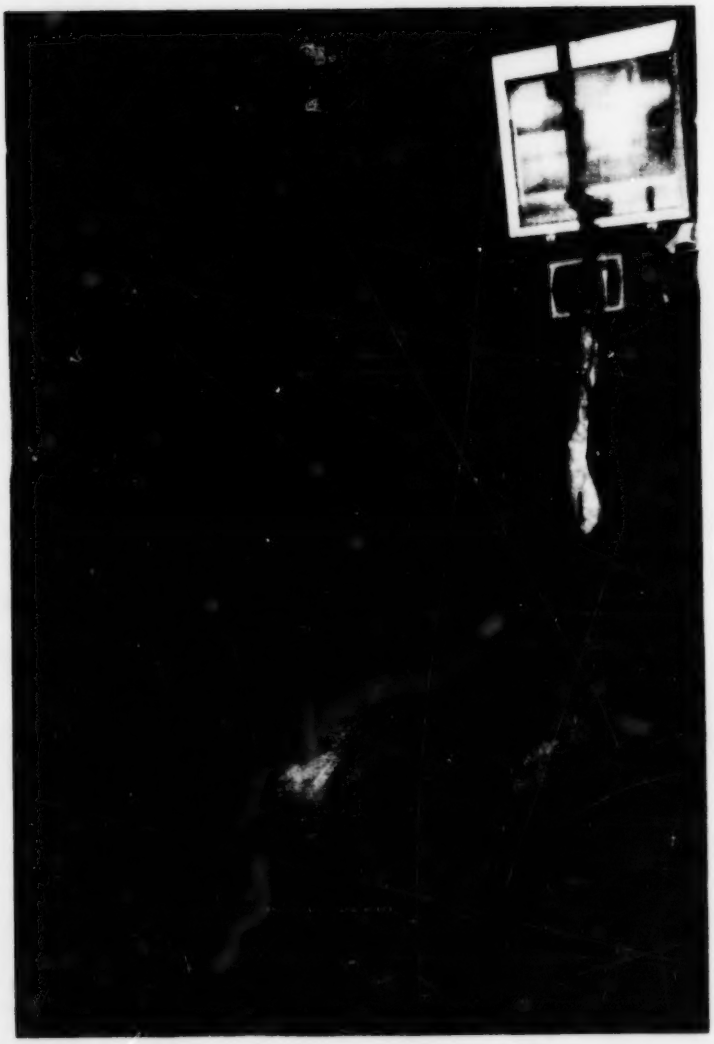

Figure 33 Installation Error at New Seal on Unit 8 CJ - Misaligned Bolt Holes

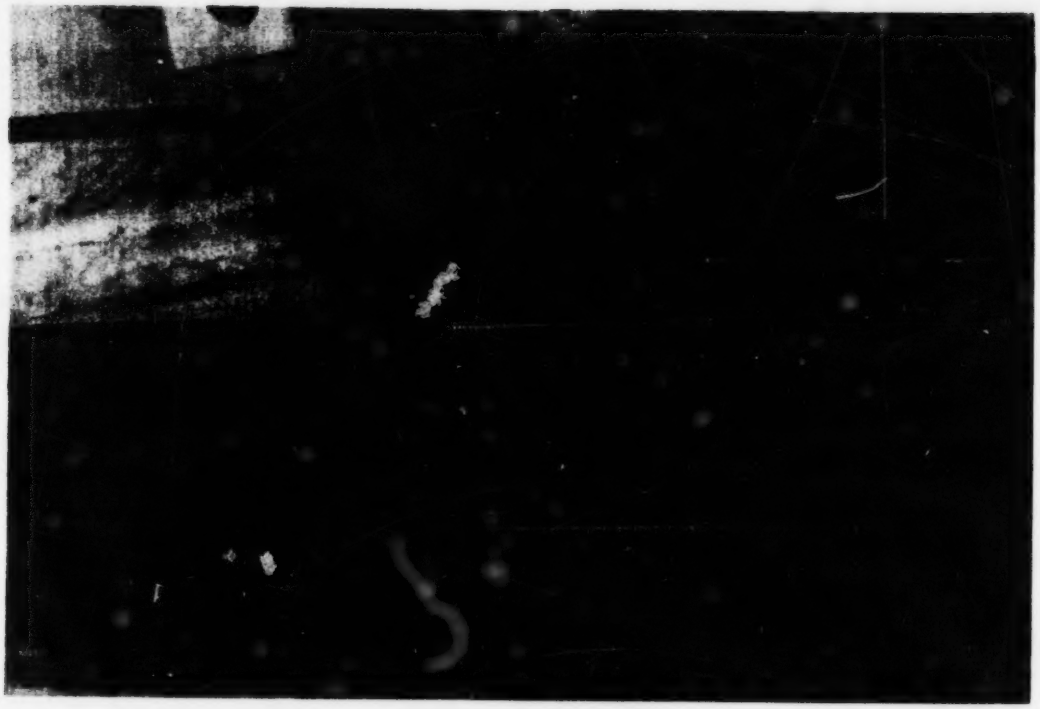

Figure 34 Installation Error on New Seal at Unit 6 CJ - Excess RTV

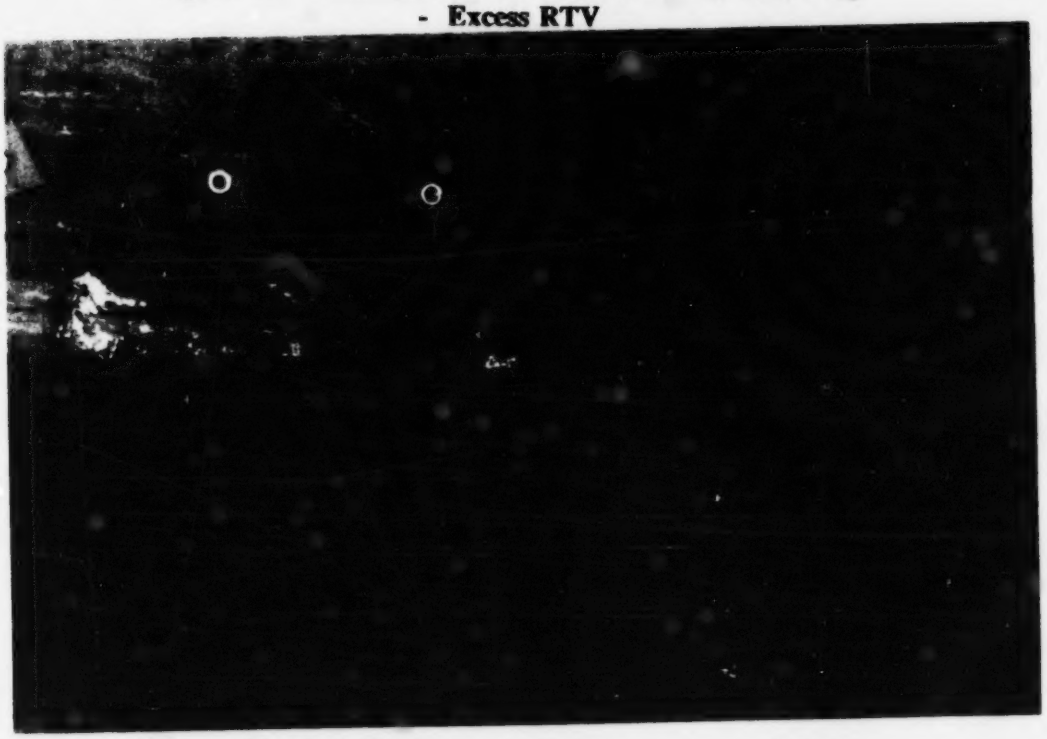

Figure 35 Installation Error on New Seal at Unit 7 CJ - Excess RTV

Figure 36 Repair in Seal CJ 66

Figure 37 Splicing - Cutting Rubber Down to the Fabric in Strips

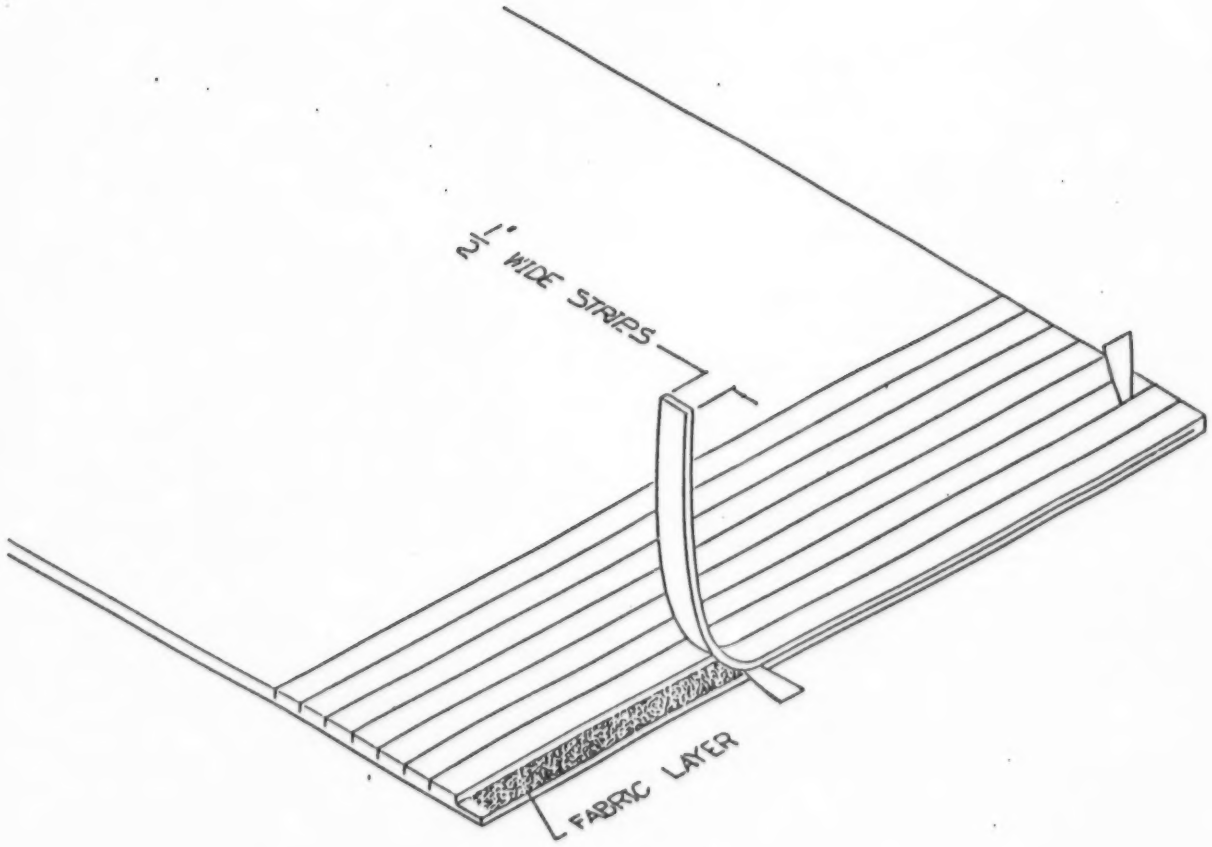

Figure 38 Splicing - Removing Rubber Strips

Figure 39 Splicing - Removing Rubber Strips

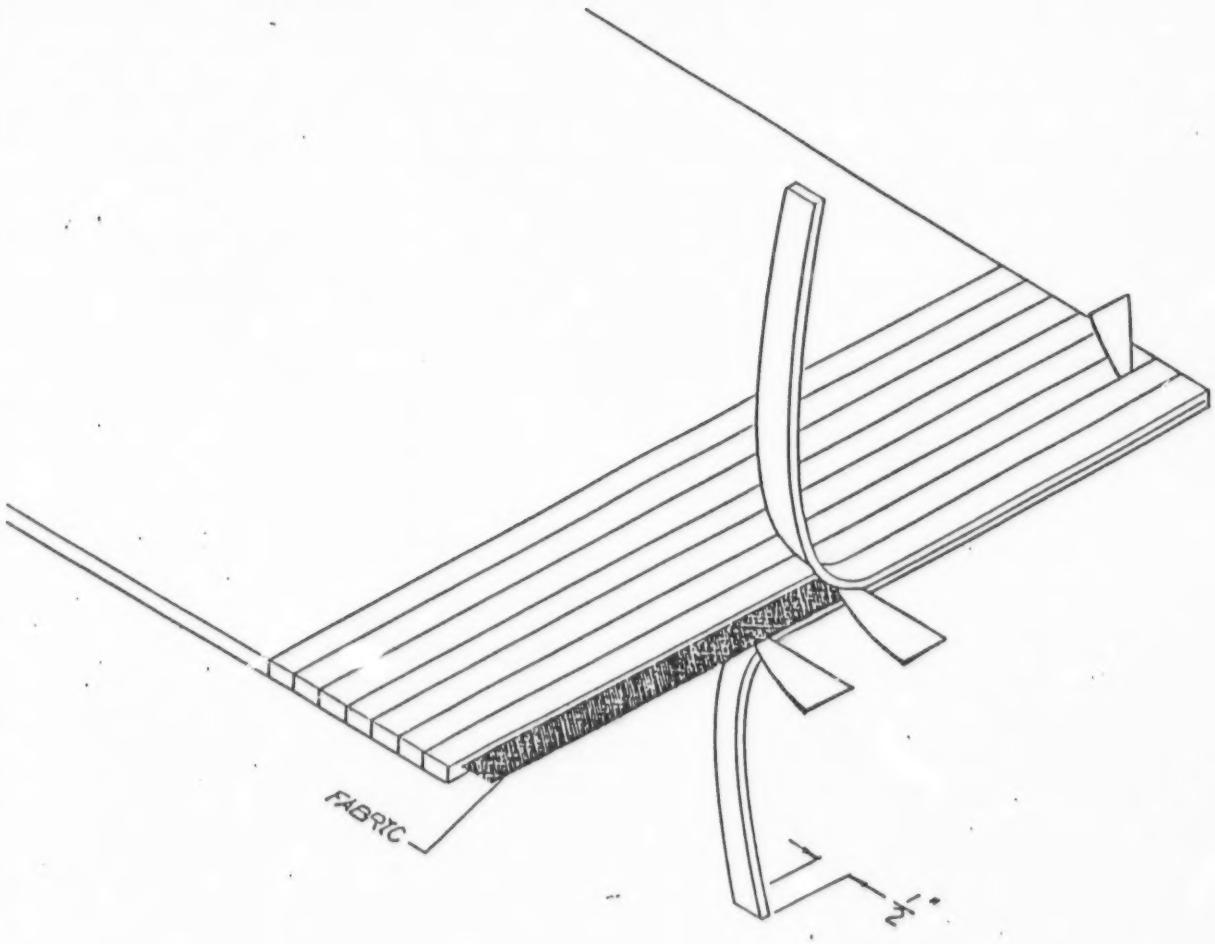

Figure 40 Splicing - Removing Rubber from Both Sides of Fabric

Figure 41 Splicing - Cleaning the Splice End with Acetone

Figure 42 Splicing - Cleaning the Splice with Acetone

Figure 43 Splicing - Protecting the Splice End in Plastic

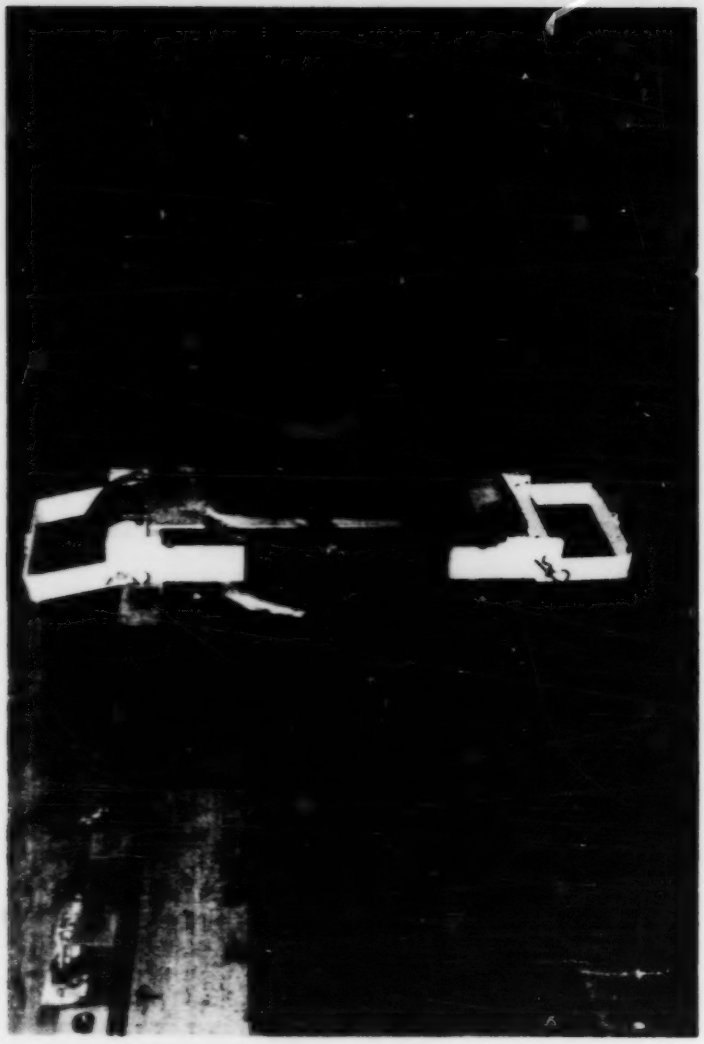

Figure 44 Splicing - Splice Ends with Lower Half of Press

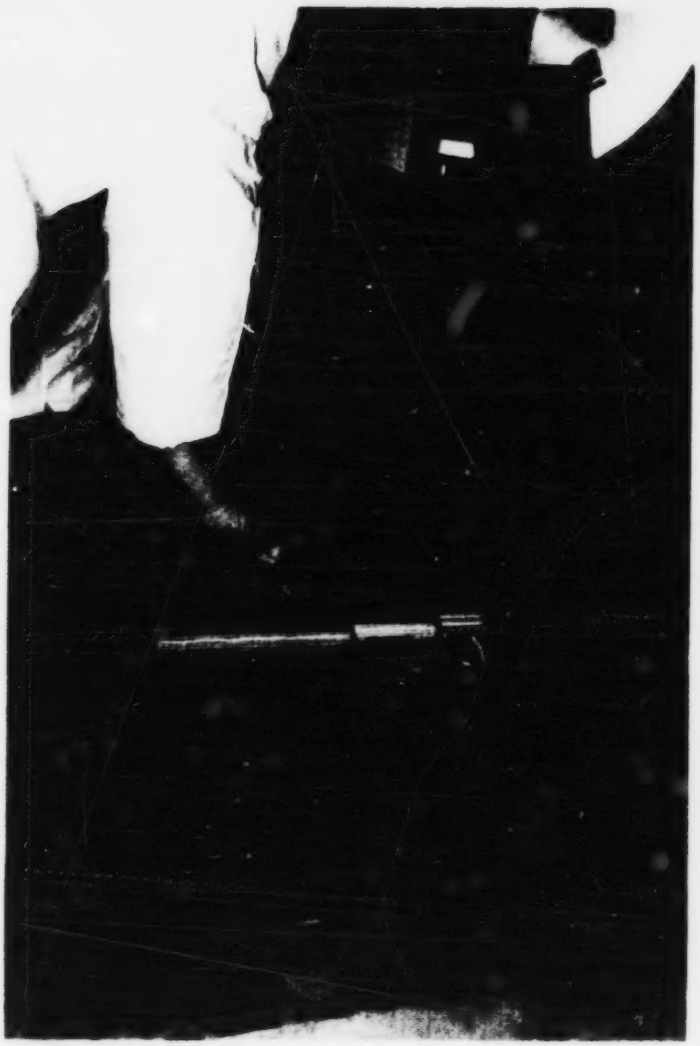

Figure 45 Splicing - Placing 0.05 cm Thick Splicing Compound on One End of Splice

Figure 46 Splicing - Trimming and Smoothing Splicing Compound

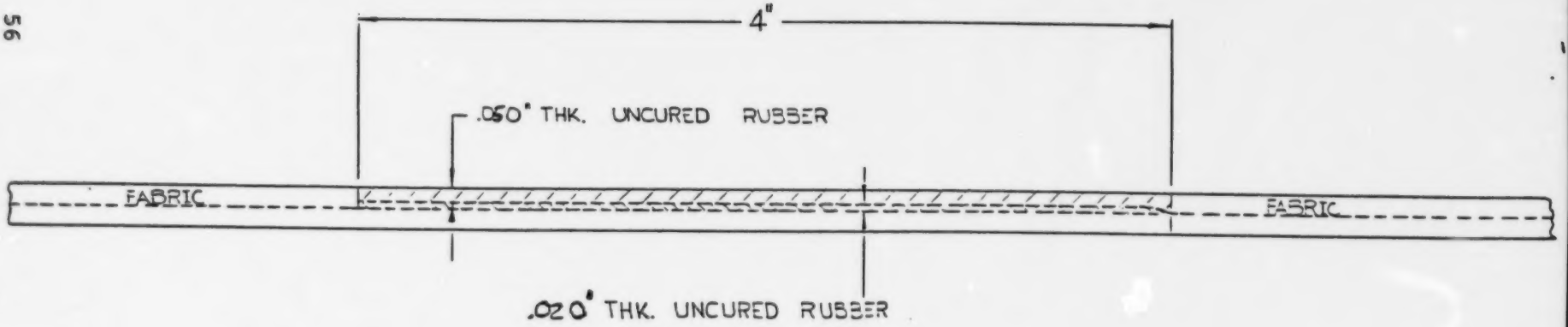

Figure 47 Side View of Seal Splice

Figure 48 Splicing - Bringing Other End of Seal to Form an Overlap

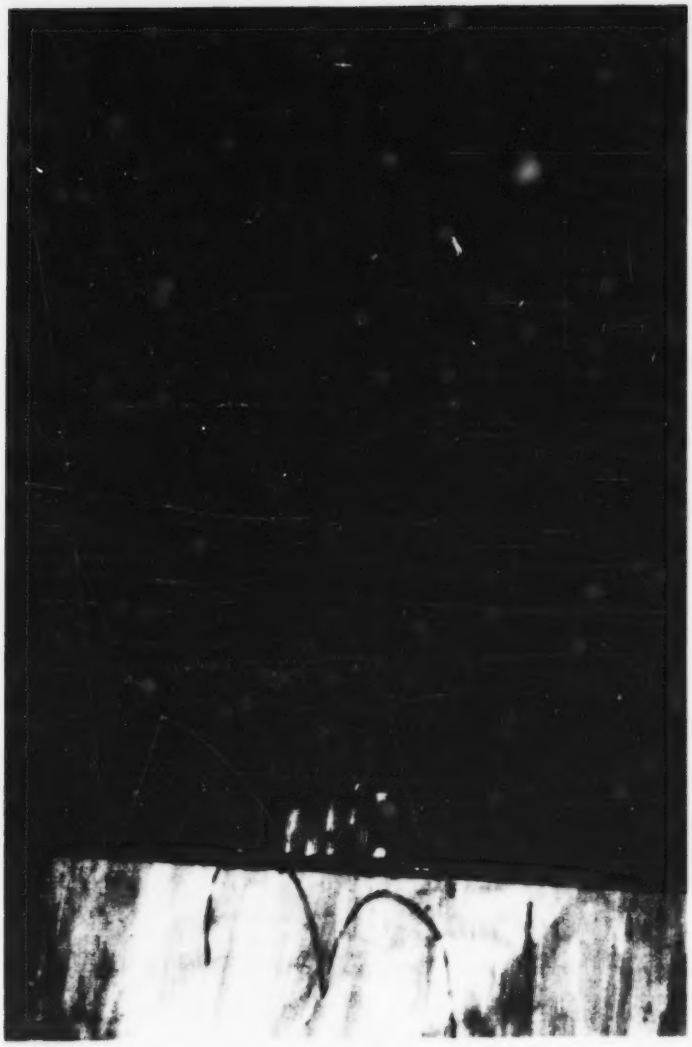

Figure 49 Splicing - Splice After Two Ends Brought Together

Figure 50 Splicing - Laying Down 0.13 cm Layer of Splicing Compound

Figure 51 Splicing - Filling Gaps with Strips of Splicing Compound

Figure 52 Splicing - Filling In Gaps with Splicing Compound

Figure 53 Splicing - Filling In Gaps with Strips of Splicing Compound

Figure 54 Splicing - Splice Ready for Curing

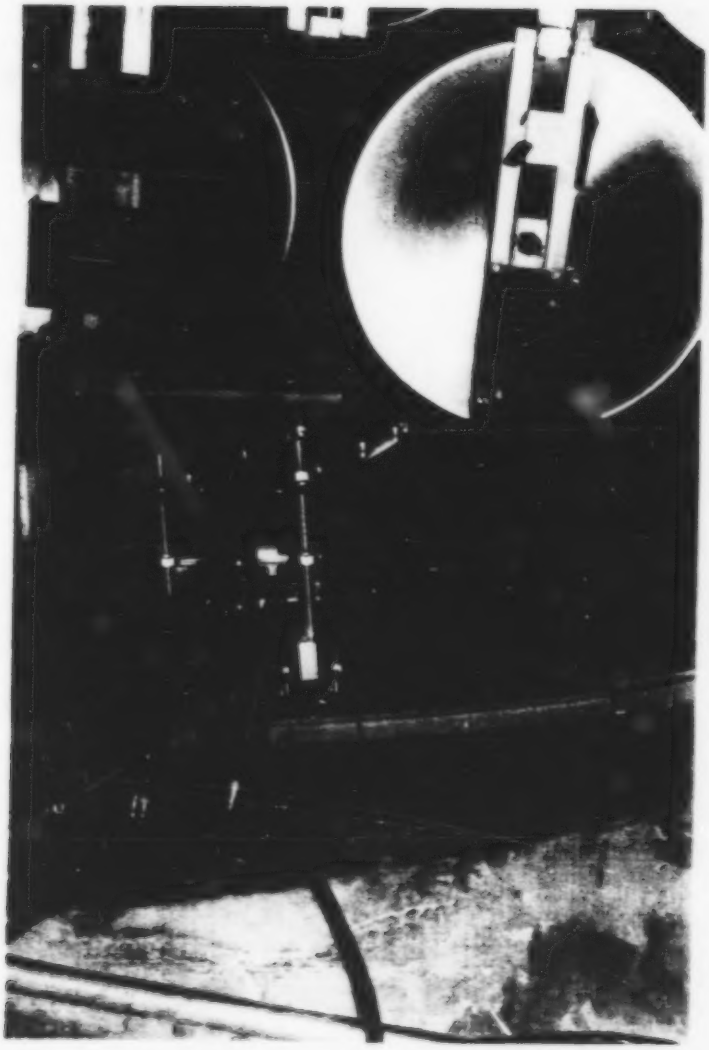

Figure 55 Splicing - Splice Curing in Press

Figure 56 Completed Splice in Seal CJ 5

Figure 57 Test Coupon Affixed to North PRD Wall